Space Science Seminar
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10:30 a.m.
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Efficient Nonthermal Particle Acceleration During Magnetic Reconnection in Magnetically-Dominated Flows

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Host: Dr. Colleen Wilson-Hodge (sponsored by ZP12)

Astrophysical magnetic-reconnection sites have long been expected to be sources of high-energy particles. Recent observations of solar flares and models of gamma-ray bursts and TeV blazars have motivated us to better understand magnetic reconnection and its associated particle acceleration in plasma conditions where the magnetic energy is dominant. We will present fully kinetic particle-in-cell simulations of anti-parallel magnetic reconnection in the highly magnetized regime (with the magnetization parameter sigma >> 1 or plasma beta << 1). The magnetic energy is converted efficiently into kinetic energy of nonthermal relativistic particles in a power-law spectrum. For a sufficiently large closed system and strong magnetic field, the power-law index approaches “p=1”. The dominant acceleration mechanism is a first-order Fermi process accomplished through the curvature drift motion of particles in magnetic flux tubes along the electric field induced by fast plasma flows. We will show simulations in three dimensions and with open boundary conditions. We will also present an analytical model for the formation of the power-law distribution and show that the nonthermal distribution may be a common feature of magnetically-dominated reconnection.

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